NSF-Sponsored Post-Earthquake Geotechnical Reconnaissance Efforts

GEER

Geotechnical Earthquake Engineering Reconnaissance

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GEER Working Group and Advisory Panel

Working Group: J.-P. Bardet, D. Frost, R. Kayen, W. Lettis, E. Rathje, N. Sitar, T.L. Youd, and J. Bray as Chair

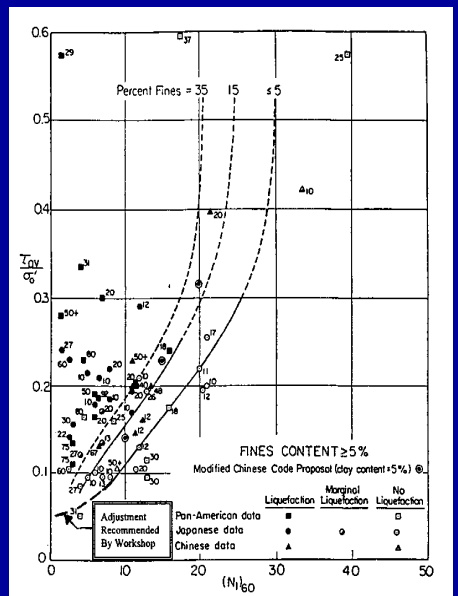
Advisory Panel: : D. Bloomquist (LiDAR), R. Borcherdt (USGS), R. Boulanger, L. Cluff (Geologist), M. Crawford (satellite imaging), R. Crippen (NASA satellite imaging), C. Edwards (TCLEE), S. Kramer, R. Hanson (Structural Engineer), L. Harder (State of CA), T. Holzer (USGS), I.M. Idriss, J. Love (EERI LFE & Structural Engineer), J. Martin, R. Olsen (U.S. Corps of Engineers), T. O'Rourke (EERI), R. B. Seed, P. Somerville (SCEC), J. Stewart, K. Tierney (Social Scientist), and H. Yeh (Tsunami Researcher)

NEED

Earthquake engineering is an experience-driven field.

The importance of detailed mapping and surveying of damaged areas relative to general surveys cannot be overemphasized.

They provide the hard data of the well-documented case histories that drive the development of many of the empirical procedures used in practice and shape our understanding.



OBJECTIVES

The GEER activity will develop a systematic approach to conducting NSF-sponsored post-EQ reconnaissance efforts.

This project is seeking to establish a system that formalizes the manner in which post-earthquake reconnaissance efforts are organized by the GeoPrograms of NSF.

Recent Geotechnical Engineering Earthquake Reconnaissance Efforts
(sponsored through the NSF SGER Program)

1989 Loma Prieta EQ (e.g. Seed et al. 1990)

1994 Northridge EQ (e.g. Stewart et al. 1994)

1995 Kobe EQ (e.g. Akai et al. 1995)

1999 Central Mexico EQ (e.g. Pestana et al. 1999)

1999 Kocaeli EQ (e.g. Youd et al. 2000)

1999 Chi-Chi EQ (e.g. Uzarski & Arnold 2001)

1999 Duzce EQ (e.g. Ansal et al. 1999)

2001 Bhuj EQ (e.g. Jain et al. 2002)

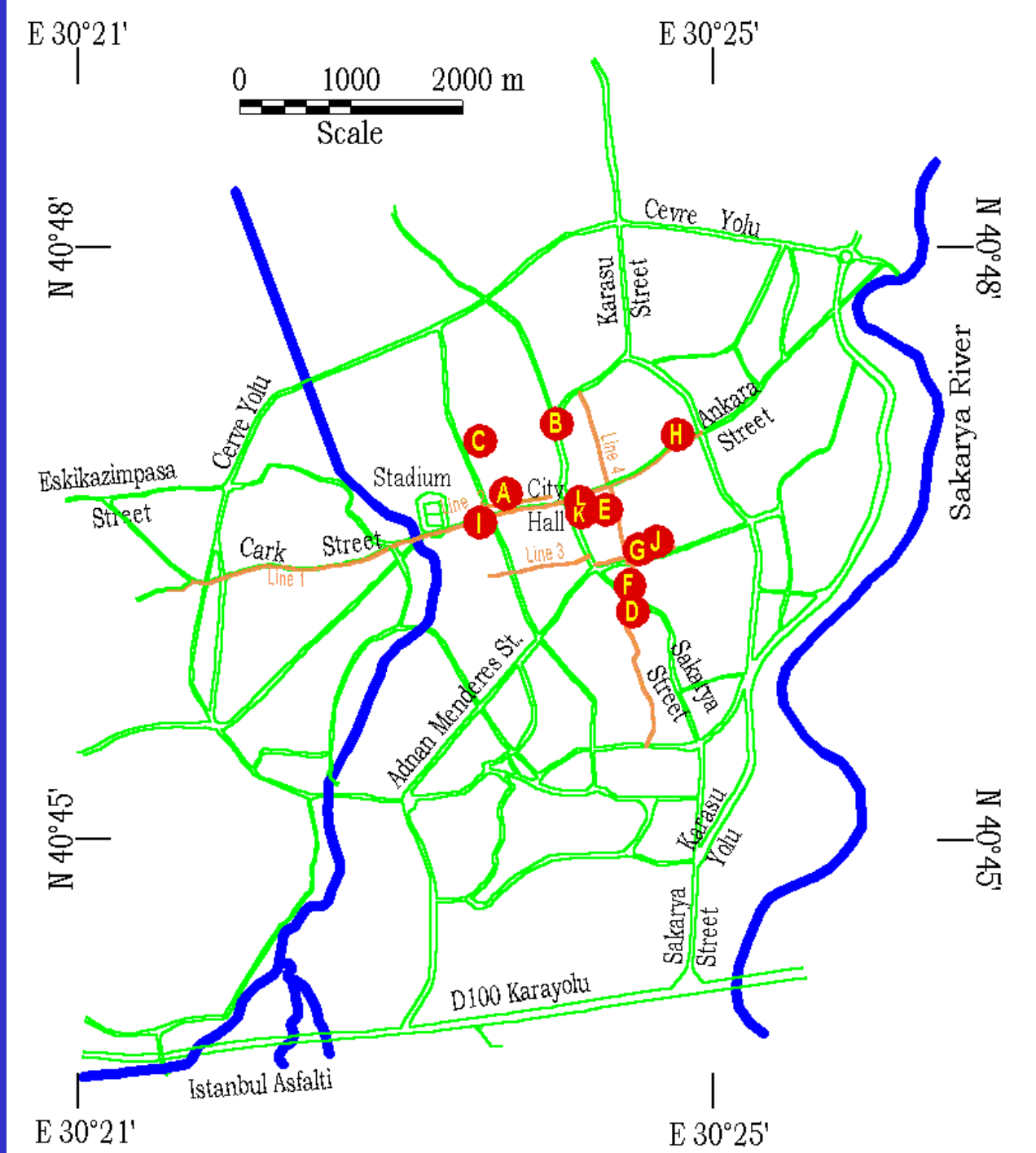
2001 Nisqually EQ (e.g. Bray et al. 2001)

2001 Southern Peru EQ (e.g. Wartman et al. 2002)

2002 Denali EQ (e.g. Kayen et al. 2003)

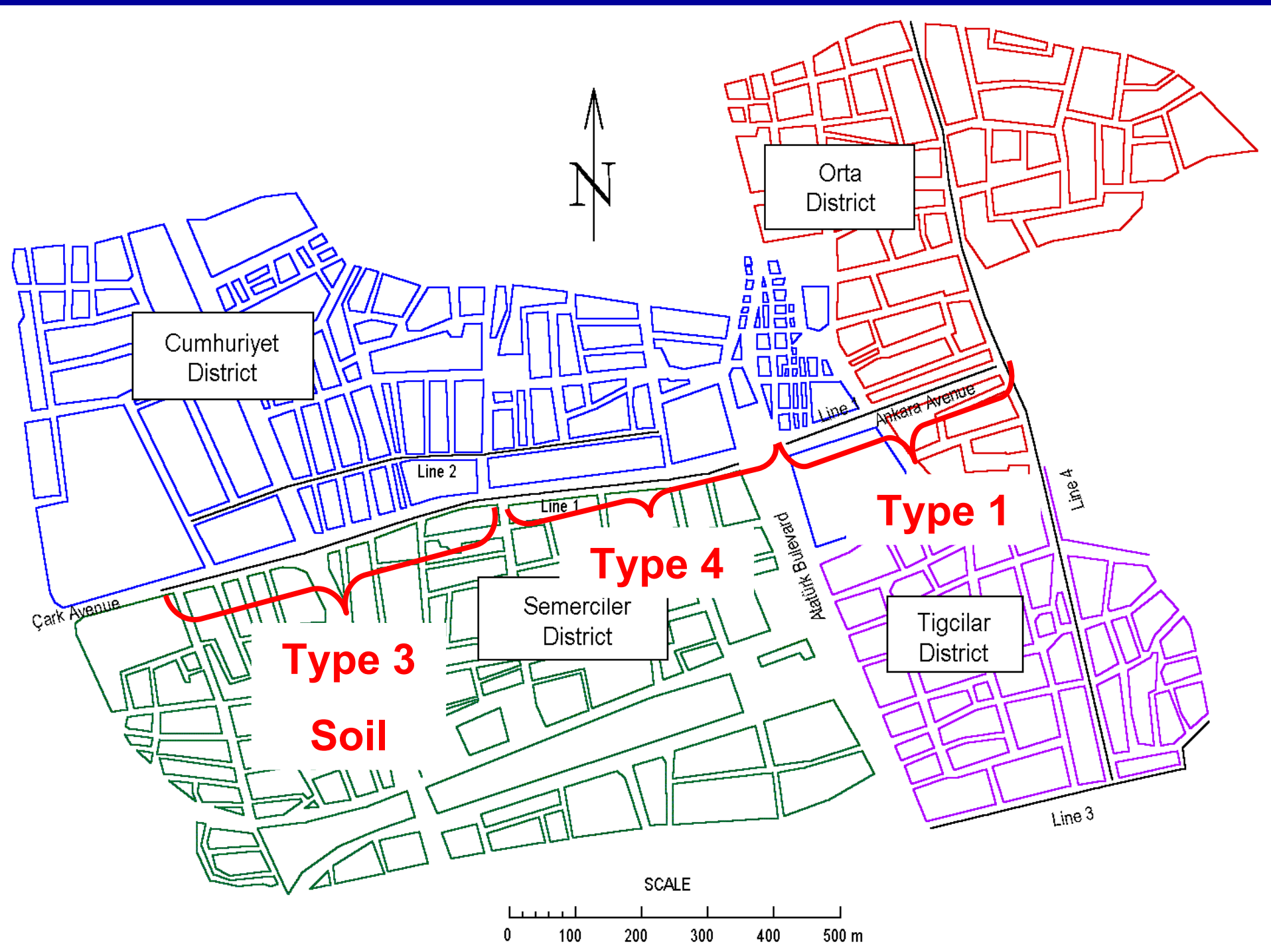
2003 Colima, Mexico EQ (e.g. Wartman and Rodriguez-Marek 2003)

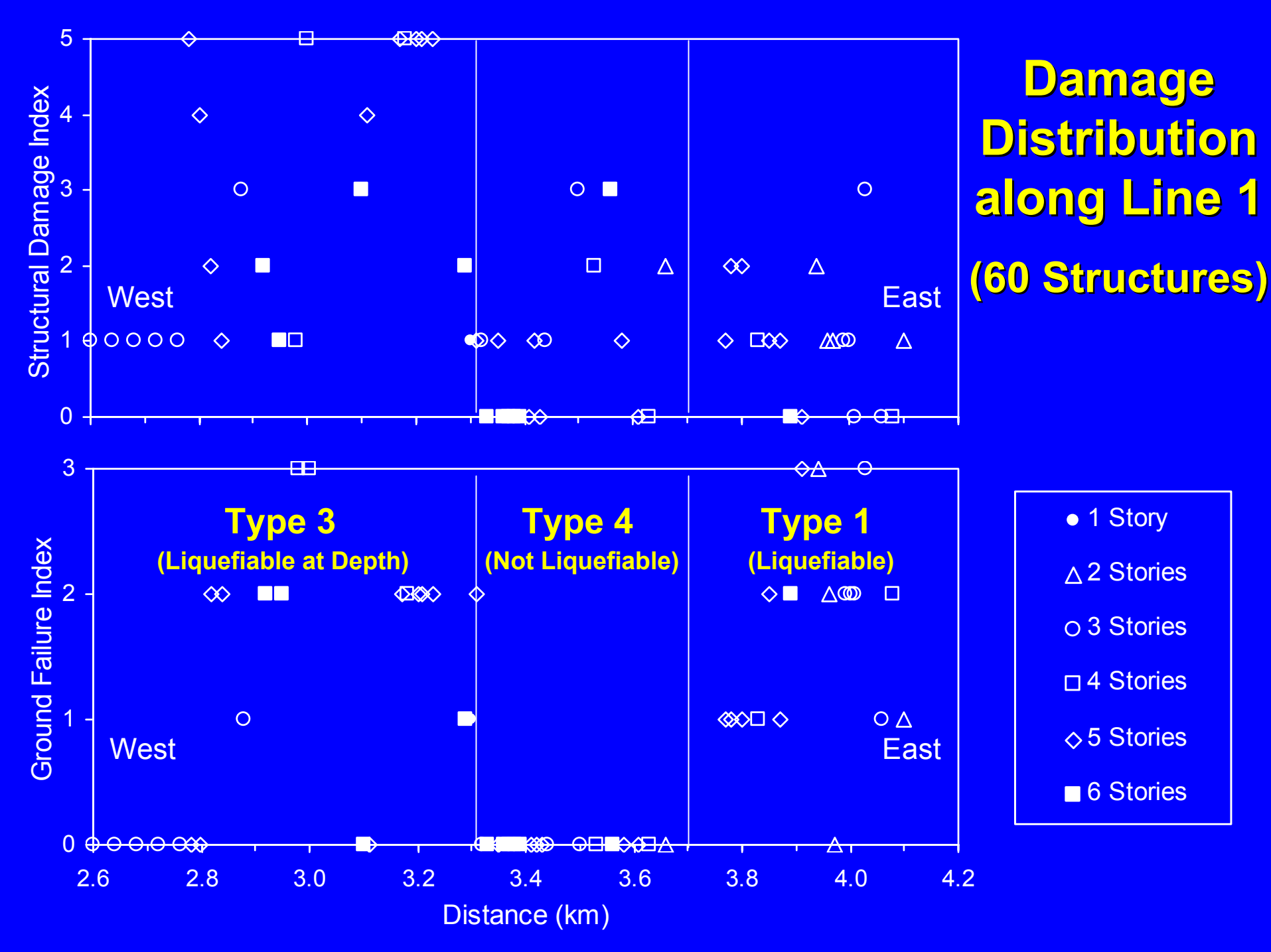
1999 Kocaeli Earthquake: A. Ansal, N. Abrahamson, J. Bachuber, J. P. Bardet, A. Barka, M. Baturay, M. Berilgen, R. Boulanger, J. Bray, O. Cetin, L. Cluff, T. Durgunoglu, D. Erten, M. Erdik, D. Frost, I. M. Idriss, T. Karadayilar, A. Kaya, W. Lettis, J. Martin, J. Mitchell, G. Olgun, A. Onalp, T. O'Rourke, W. Paige, E. Rathje, C. Roblee, R. Sancio, W. Savage, R. Seed, P. Somerville, J. Stewart, B. Sunman, B. Swan, C. Synolakis, S. Toprak, D. Ural, R. Witter, M. Yashinski, T. Yilmaz, L. Youd



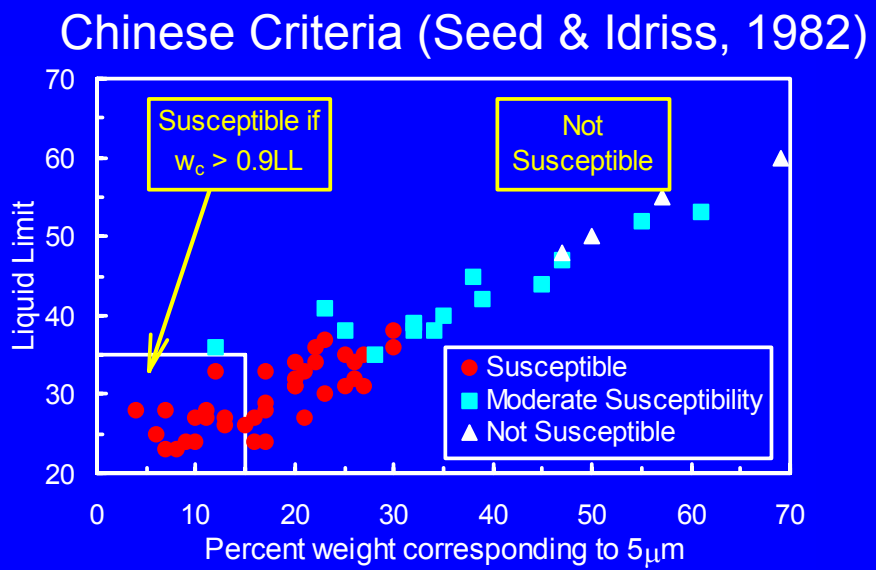
City of Adapazari

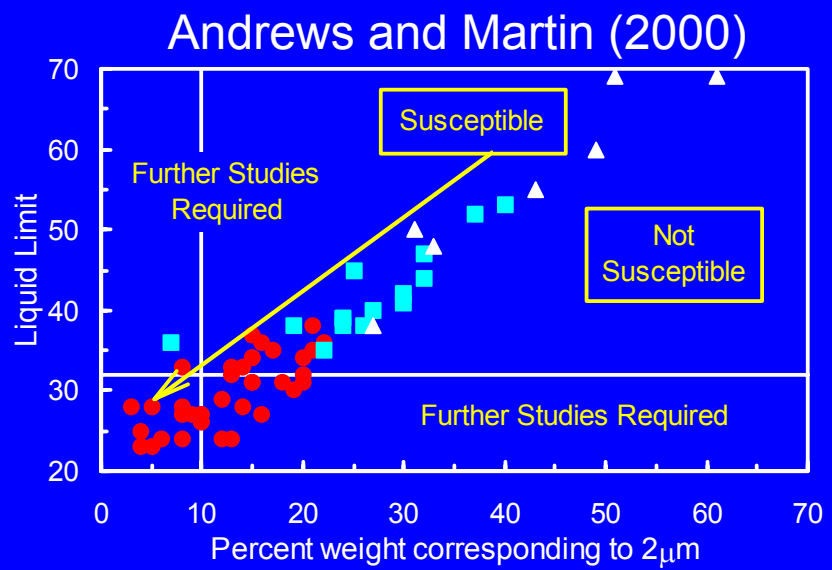
Post-EQs Surveys

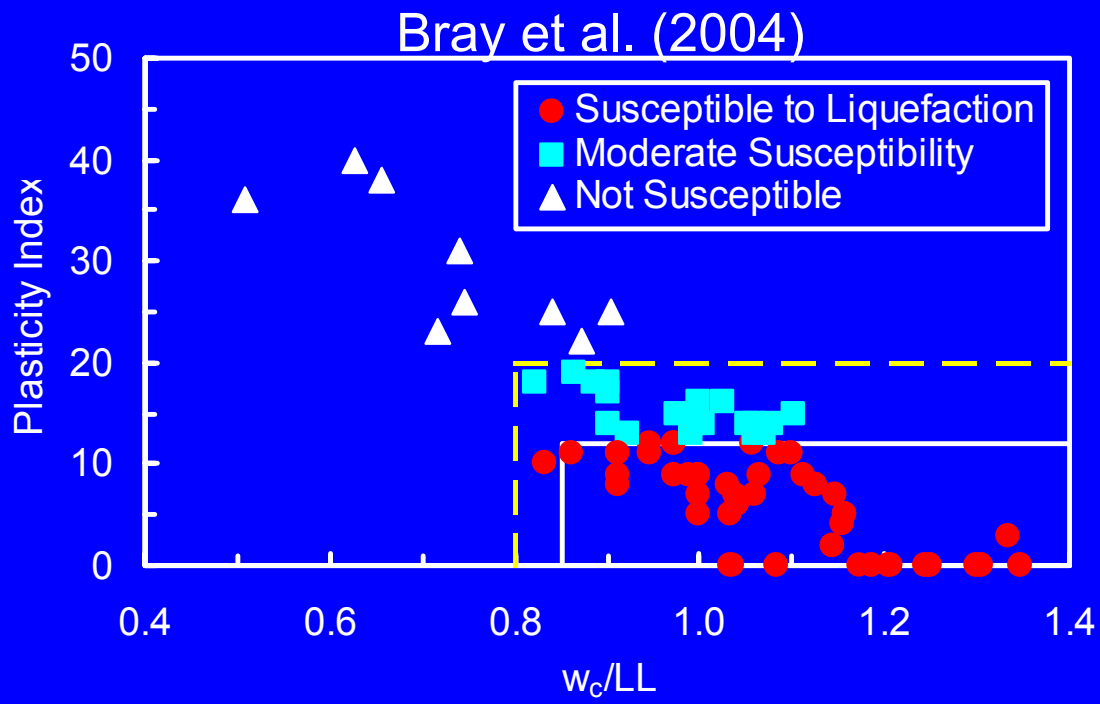

N
Orta
District
Cumhuriyet
District
Semerciler
District
Tigcilar
District
Line 1
Ankara Avenue
Line 2
Line 1
Çark Avenue
Atatürk Bulevard
Line 4
Line 3
Type 1
Type 4
Type 3
Soil
SCALE
0
100
200
300
400
500 m

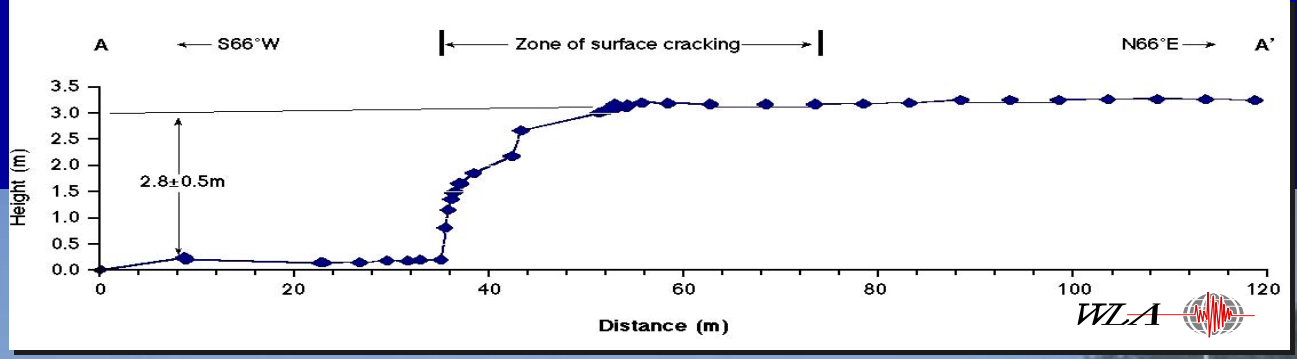

Damage Distribution along Line 1
(60 Structures)
Structural Damage Index
5
4
3
2
1
0
West
East
Ground Failure Index
3
2
1
0
Type 3
(Liquefiable at Depth)
Type 4
(Not Liquefiable)
Type 1
(Liquefiable)
West
East
2.6
2.8
3.0
3.2
3.4
3.6
3.8
4.0
4.2
Distance (km)
1 Story
2 Stories
3 Stories
4 Stories
5 Stories
6 Stories

Liquefaction Susceptibility of Fine-Grained Soils

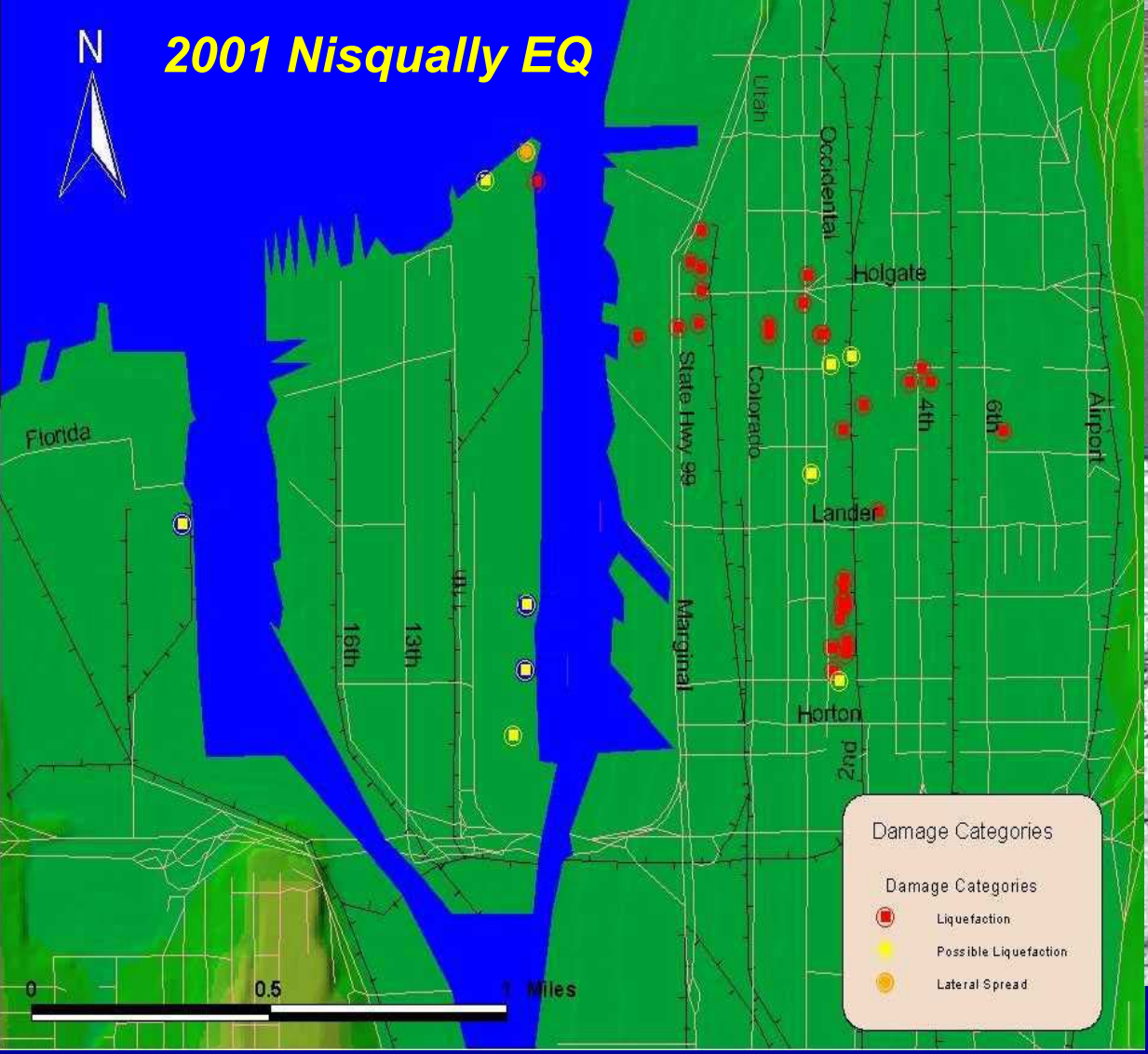








1999 Chi-Chi EQ: J. P. Bardet, R. Boulanger, J.D. Bray, Y.-W. Chan, C.-Y. Chang, S. Chang, C.-H. Chen, L. Cluff, L. Harder, A-B. Huang, S. Huang, J.W. Ju, K. Kelson, S. Kieffer, S. Kramer, M.-J. Kuo, W. F. Lee, H-L. Lin, C-H. Loh, M. McRae, C-Y. Ou, W. Perkins, G. Rix, C. Roblee, R.B. Seed, J.-D. Shen, N. Sitar, J. Stewart, L. Teng, J. I. Sun, D. Wells, R. Wright and M. Yashinsky

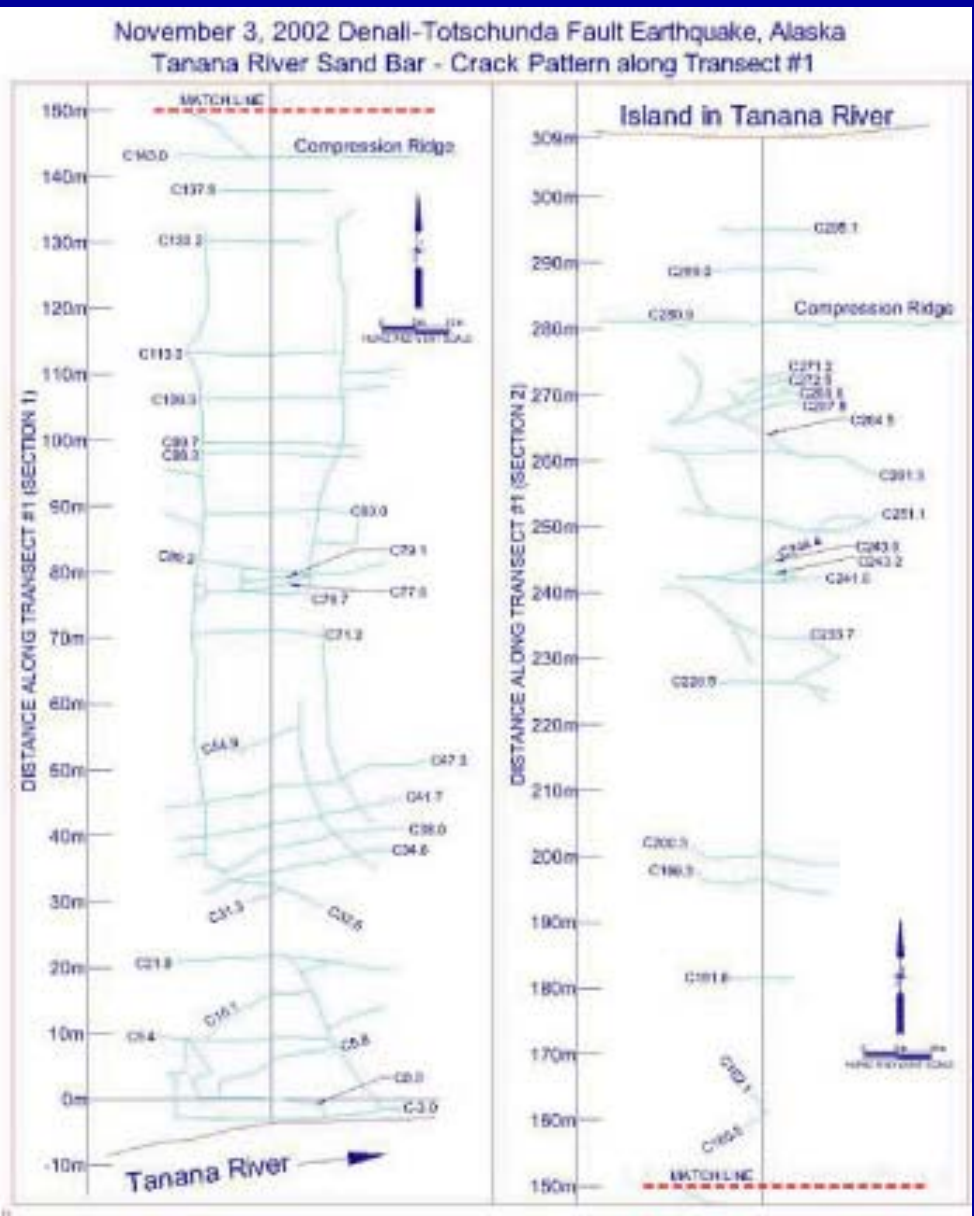


J. Bray, R. Sancio, A. Kammerer, S. Merry, A. Rodriguez-Marek, B. Khazai, S. Chang, A. Bastani, B. Collins, E. Hausler, D. Dreger, W. Perkins, & M. Nykamp; with J. Arnold, D. Booth, W. P. Grant, J. Hagedorn, M. Hamm, J. Hubbell, R. Hudson, S. Kramer, R. Mitchell, B. Muhunthan, S. Palmer, M. Vendetti, M. Wallinger, B. Topolski, K. Troost

http://peer.berkeley.edu/nisqually/geotech/

2002 Denali Earthquake: Detailed Surveying

DGPS & Line-drawn mapping of polygon-shaped lateral spreads: 1.6%-3.8% shear strain toward Tanana river



Mapped by Sitar, Kayen, Collins, and others

Anticipated Research Accomplishments

GEER WG and AP meet to promote and incorporate:

1. Use of new technologies for EQ reconnaissance

2. Use of existing technologies in an improved coordinated manner to document performance

3. Better training of those involved in EQ reconnaissance efforts, both in terms of effectiveness and safety; provide access to equipment required for state-of-the-art surveying

4. Timely and accurate results for the post-EQ survey efforts in terms of web-based short reports, data files, and final reports

5. A systematic mechanism for responding to EQs through the NSF SGER program

Some Key Action Items

- **Better incorporation of GEER activity within USGS Cir. 1242:**

  Coordination with EERI-LFE, USGS, and Other U.S. and International Post-EQ Reconnaissance Organizations

- **Opportunities and challenges:**

a. **Earthquake reconnaissance tools: GIS integration, GPS/video/picture**

b. **Use of geologic data and techniques, and the role of the practitioner**

c. **Satellite and other aerial imaging data for use in EQ reconnaissance**

d. **Development of quantitative data (lessons learned from past EQs)**

e. **Rapid dissemination of post-EQ reconnaissance data**

f. **Systematic collection and archiving of post-EQ data**

g. **NSF cyberinfrastructure initiative and NEES collaborative research**

Preliminary Post-EQ Response Plan

a. Threshold for Response

b. Decision Process and Coordination

c. Application for NSF SGER Funds

d. Execution

e. Equipment

f. Other Issues

Objectives of this Meeting:

1. Promote Awareness of the GEER Activity
2. Define Its Role in Post-EQ Reconnaissance (within USGS Circular 1242)
3. Cross-Fertilization through Sharing of Perspectives from Other Post-EQ Recon. Activities
4. Use of Existing Techniques & Technologies, and Development of Emerging Technologies
5. Optimal Means for Dissemination and Cataloging of Data
6. Moving Forward? (e.g. Workshop, Training, Formalization)